Amendments to Drawings:

The attached sheet of drawings includes changes to Figure 3. This sheet, which includes Figure 3, replaces the original sheet including Figure 3. In Figure 3, elements "x_{i1}" and "x_{iK-1}" have been changed to elements "$\underline{x}_{i1}$" and "$\underline{x}_{iK-1}$", respectively.

REMARKS/ARGUMENTS

Claims 1-64 are pending in this application. Claims 1, 2, 7, 8, 13, 14, 19, 20, 25, 26, 31, 32, 37, 38, 43, 44, 49, 50, 55, 56, 61 and 63 have been amended to more distinctly claim the subject matter which the Applicant regards as the invention. Numerous claims have been amended to make stylistic revisions without intending to affect the scope of the claims. The specification and drawings have been amended to address the objections raised by the Examiner and to place the application in better condition for allowance. The Applicant submits that no new matter has been added.

Claim Rejections

Claims 1-3, 5, 7-9, 11, 13-15, 17, 19-21, 23, 25-27, 29, 31-33, 35, 37-39, 41, 43-45, 47, 49-51, 53, 55-57, 59 and 61-64 stand rejected under 35 USC § 102 as being anticipated by Misra et al. ("A computationally efficient hybrid of joint detection and successive interference cancellation", IEEE 53rd Vehicular Technology Conference, May 2001, Vol. 3, pages 1784-1788) and Pan et al. ("Low complexity data detection using fast Fourier transform decomposition of channel correlation matrix", IEEE Global Telecommunications Conference, Nov. 2001, Vol. 2, pages 1322-1326). The remaining claims stand rejected under 35 USC § 103 as being unpatentable over Misra et al. in view of Pan et al. These rejections are respectfully traversed.

The present invention is directed to a method and apparatus for determining user symbols from a plurality of received signals in a shared spectrum, where samples of the received user signals are produced as a receive vector that is segmented into a plurality of segments. Symbols for each user are determined from

each segment, and the determined symbols corresponding to each segment are combined into a data vector. Claim 1, for example, requires:

> segmenting the received vector into a plurality of segments;
> for each segment, successively determining symbols for each user by determining symbols for one user and removing a contribution of that one user from the corresponding segment; and
> assembling the determined symbols corresponding to each segment into a data vector.
> (emphasis added).

The processing of segments of the received vector to determine symbols as claimed is not taught by Misra et al. or Pan et al., and is more computationally efficient than processing of the entire received vector as a whole.

Misra et al. discloses a receiver for multi-user detection using joint detection and successive interference cancellation. The vectors $\underline{r}^{(k)}$ taught by Misra et al. are not segments of a vector $\underline{r}$. The vector $r^{(k)}$ is defined as the contribution of the k^{th} signal burst to the overall received vector (see page 1785, col. 2 of Misra et al.), where in page 1785, col. 1 of Misra et al. it specifies that there are "a total of K signal bursts that arrive simultaneously at the receiver, superposed on top of each other as one burst in an observation interval". Thus, vector $r^{(k)}$ of Misra et al. comprises a signal burst that is superposed with other signal bursts and that has its own corresponding spreading code and estimated channel response (see page 1785, col. 1 of Misra et al.).

Pan et al. defines a vector $\underline{r}_m^{(k)}$ as the contribution of the k^{th} burst to an m^{th} chip-rate sub-vector. However, this chip-rate sub-vector corresponds to a sub-sequence resulting from oversampling of the received signal and not from segmenting of the original received vector $\underline{r}$, as explained on page 1323, column 2:

> The signal model above is formulated for chip rate sampling. The chip rate is specified as 3.84 Mega chips per second (Mcps) in 3GPP UTRA system. Practical receivers typically operate at "over sampled" mode, such as twice the chip rate or higher rates to improve robustness with respect to timing error. In this case the

> received signal is over sampled and can be represented by multiple sub-sequences, each of which is sampled at chip rate with a different time offset with respect to each other. Let $r_m^{(k)}$ be the contribution of the k^{th} burst to its m^{th} chip-rate sub-vector $\underline{r}_m$.

In contrast, according to the present invention, each segment $\underline{r}_i$ includes contributions from all user signals (all signal bursts), such that each segment is processed to successively extract the symbols for each user. The claimed sgment-wise "successively determining symbols for each user" simply cannot be done in Misra et al. or Pan et al., because the vector $r^{(k)}$ of Misra et al. and $r_m^{(k)}$ of Pan et al. only includes the contribution of a single burst (i.e. a single user).

According to the present invention, the segments of the received vector are each processed separately using equalization and sequential interference cancellation to determine user symbols, as explained in paragraph 0032 and equations 4A and 4B:

> [0032] Two approaches to solve Equation 3 use an equalization stage followed by a despreading stage. Each received vector segment, $\underline{r}_i$, is equalized, step 54. One equalization approach uses a minimum mean square error (MMSE) solution. The MMSE solution for each extended segment is per Equation 4A.
>
> $$\hat{\underline{s}}_i = (H_s^H H_s + \sigma^2 I_s)^{-1} H_s^H \underline{r}_i$$
>
> Equation 4A
>
> σ^2 is the noise variance and I_s is the identity matrix for the extended matrix. $(\cdot)^H$ is the complex conjugate transpose operation or Hermetian operation. The zero forcing (ZF) solution is per Equation 4B
>
> $$\hat{\underline{s}}_i = (H_s^H H_s)^{-1} H_s^H \underline{r}_i$$
>
> Equation 4B

Neither Misra et al. nor Pan et al. teach determining user symbols from segments of a received vector as shown above in Equations 4A and 4B of the present invention. In fact, both Misra et al. and Pan et al. teach away from determining

symbols from each segment because Misra et al. and Pan et al. teach determining symbols using the entire received vector. The determining of symbols from the entire received vector $\underline{r}$ is shown explicitly in equations (4a) and (4b) on page 1786 of Misra et al.:

$$\underline{d} = (A^H A)^{-1} A^H \underline{r} \qquad (4a)$$

$$\underline{d} = (A^H A + \sigma^2 \cdot I)^{-1} A^H \underline{r} \qquad (4b)$$

Likewise, the determining of symbols from the entire received vector $\underline{r}$ is shown explicitly in equations (10) and (11) on page 1324 of Pan et al.:

$$\hat{\underline{s}} = (H_c'^H H_c')^{-1} H_c'^H \underline{r} \qquad (10)$$

$$\hat{\underline{s}} = (H_c'^H H_c' + \sigma^2 I)^{-1} H_c'^H \underline{r} \qquad (11)$$

Determining symbols from segments $\underline{r}_i$ of the overall received vector $\underline{r}$, as taught in the present invention, reduces the computational complexity because the ZF or MMSE algorithm as applied to solve the above equations is performed on a smaller matrix.

Neither Misra et al. nor Pan et al., teach or suggest determining symbols from segments of the received vector as in the present invention. Accordingly, Misra et al. or Pan et al. do not teach or suggest the features of independent claims 1, 7, 13, 19, 25, 31, 37, 43, 49, 66, 61 and 63. The remaining claims are dependent upon claims 1, 7, 13, 19, 25, 31, 37, 43, 49, 66, 61 and 63 and are, accordingly, also believed to be allowable.

Based on the arguments presented above, withdrawal of the rejections of the claims 1-64 based on Misra et al. and Pan et al. is respectfully requested.

Conclusion

If the Examiner believes that any additional minor formal matters need to be addressed in order to place this application in condition for allowance, or that a telephone interview will help to materially advance the prosecution of this application, the Examiner is invited to contact the undersigned by telephone at the Examiner's convenience.

In view of the foregoing amendment and remarks, Applicant respectfully submits that the present application, including claims 1-64, is in condition for allowance and a notice to that effect is respectfully requested.

Respectfully submitted,

Ariela Zeira

By_____

C. Frederick Koenig, III
Registration No. 29,662
(215) 568-6400

Volpe and Koenig, P.C.
United Plaza, Suite 1600
30 South 17th Street
Philadelphia, PA 19103

CFK/CRT/dcb